# Heat: An Agent of Change

# Thermometers and Thermostats

## STUDENT ACTIVITY

Name_____

## PROBLEM

*What is the correct way to use a thermometer to take the temperature of a liquid?*

Thermometers are a common tool for measuring temperatures. They are a technological application of the fact that most liquids expand when heated. The liquid in most thermometers is either colored alcohol (often red), or mercury (usually a silverish color).

Your teacher will give you a detailed review of how to use and take data from a thermometer.

Oral Thermometer

Meat Thermometer

Thermistor Probe Thermometer

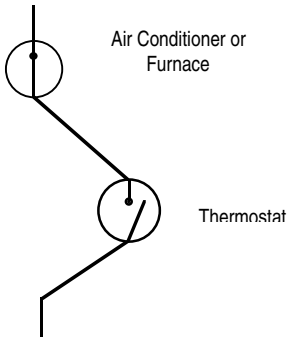
## PROCEDURE

1. Your teacher will give you some introductory information.
2. Examine the thermometer carefully without picking it up. Can you tell which end stays out of the liquid? Often there is a large reservoir of liquid at one end, called the bulb. What is its purpose? Record these answers in your laboratory notebook.
3. Hold the bulb of the thermometer carefully between two fingers while you examine the measurement scale. Most likely not all the division lines are numbered. Determine the spacing of the division lines. Record this in your laboratory notebook.
4. In your laboratory notebook, record the safety precautions to take when using a thermometer. Describe the proper actions to take if a thermometer gets broken. (Hint: What materials should be cleaned up when a thermometer breaks?)
5. Hold the bulb of the thermometer between your thumb and finger. Describe what happens to the liquid in the stem of the thermometer. Why does this happen? Record your observations in your laboratory notebook.
6. In your laboratory notebook, explain why you should always pick up the thermometer carefully by the top of the stem.

## BACKGROUND INFORMATION

The amount of expansion differs in various materials. The expansion of certain heated materials can be readily seen, while others expand less dramatically. Their expansion can only be detected by sensitive measuring equipment. Understanding the science of thermal expansion allowed inventors to create a tool called the **thermostat**. Thermostats control equipment that regulates the temperature of their surroundings. Thermostats regulate furnaces, air conditioners, and other heating and cooling equipment automatically.

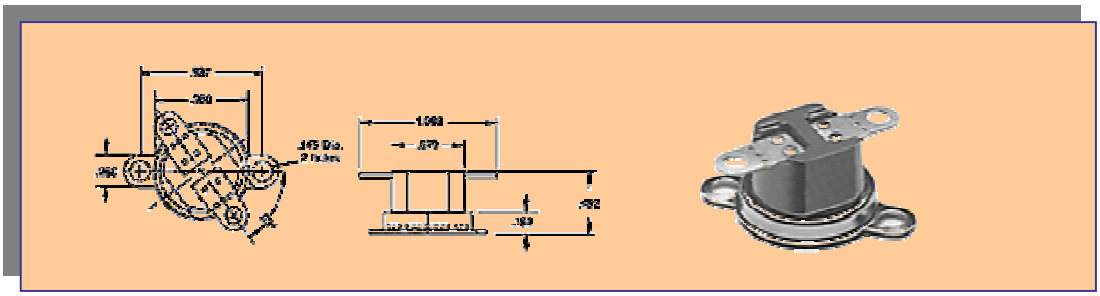
A **bimetallic strip** consists of two strips of different kinds of metal bonded together, back to back. When the temperature increases, both strips lengthen. Because they are different kinds of metal, they expand by different amounts. If the metal of the bottom strip lengthens more, but is still bonded to the top strip, the bimetallic strip must curl. The inner arc will be the shorter strip. When the temperature decreases, the bimetallic strip straightens out.




A thermostat in use is part of an electric circuit. Until a certain temperature is reached, a little gap between the bimetal strip and the wires of the equipment controlled by the thermostat keeps the circuit open. As the temperature rises, the bimetal strip bends and gradually closes the gap. When the strip has bent enough, it closes the electric circuit. Electricity flows and the air conditioner or other equipment comes on.

If the thermostat has turned on an air conditioner, the temperature will now go down. The bimetal strip cools down and starts to bend less. It then straightens up and no longer touches the wires. The circuit is opened, and electricity stops flowing. The air conditioner turns off.

You will be experimenting with strips made of two different types of materials, in this case kinds of tape. Scientists on the Genesis mission must do similar experimentation as they develop and choose appropriate materials to construct the craft and equipment for the mission. Although Genesis engineers know in general how heat affects all kinds of materials, they are especially concerned about the expansion and contraction of solids.



## PROBLEM

How can we create a model of a thermostat controlling a furnace?

## PROCEDURE

1. Get two pieces of tape, one paper masking and one plastic transparent. Stick the sticky sides together carefully. Cut off excess so you have a single flat piece of tape that is not sticky on the outside. Your bi-tape strip should be about 6" long.
2. Gently hold one end of the bi-tape strip. It should be straight.
3. Heat the other end of the strip. Record your observations in your laboratory notebook.
4. Allow the bi-tape strip to cool down to room temperature. Record your observations in your laboratory notebook.
5. Try this experiment with other types of tape. Record your observations in your laboratory notebook.

## CONCLUSION

In your laboratory notebook, record the most important rule to follow when using a thermometer. Compare with others in your lab group. Did you all pick the same rule? Discuss the reasons you each had for your choices.

Explain how one thermostat on a wall can control both the air conditioner in hot weather and the furnace in cold weather. Remember that during pleasant weather the thermostat's bimetallic strip is not completing the circuit of either the air conditioner or the furnace.